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UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

NATIONAL COOPERATIVE SOIL SURVEY TECHNICAL WORK-PLANNING CONFERENCE
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REPORT OF COMMITTEE ON CRITERIA FOR SOIL SERIES, TYPES, AND PHASES

Organized in the fall of 1953, the committee prepared a progress report following its discussions at the work-planning conference in March 1954. Major attention in those discussions was given to existing practice in the differentiation of series or phases on the basis of unconforming substrata. Consideration was also given to the subdivision of the series on some bases other than texture of surface soil and to the possible simplification of nomenclature for phases of soil types. These discussions have been continued, and the current report of the committee is a second progress report. Problems considered by the committee, together with further recommendations for action, are discussed below.

1. Unconforming Substrata as Criteria for Series and Phase Distinctions.

As reported last year, the committee was in agreement that significant differences in genetic horizons were criteria for series differentiation, regardless of the vertical uniformity or lack of it in the materials from which soils had been formed. Appreciable differences in genetic horizons were criteria for the definition of series, whether those horizons were above or within unconforming materials. Furthermore, significant shortening of the solum or comparable changes in horizons because of unconformities were also criteria for series differentiation. Thus, the problem as defined last year concerns soils in which genetic horizon differences normally considered to be series criteria are not involved.

Problems in the use of unconforming substrata as criteria for series or phase distinctions are most common to soils that have relatively shallow solums, low degrees of horizonation, or both. Where weathering and horizon differentiation have extended to great depths, the problem seldom arises. The principal difficulties occur where soils have been formed from lacustrine sediments, glacial outwash, coastal plain deposits, alluvium laid down by streams, loess, volcanic ash, and shallow glacial till. Both the depth to and character of the substrata have been used in the differentiation of both series and phases. Properties of substrata used as bases for differentiation have included texture, compaction, permeability, reaction, carbonates, mode of deposition, and degree of consolidation (bedrock).



At least a few soil series have been recognized on the basis of unconforming substrata, or very largely on that basis, in all sections of the country in the past. Recent practice has included the recognition of additional series because of substratum differences in some sections and the recognition of phases for comparable differences in other sections. Arguments for the two courses of action were considered and summarized last year. They are reproduced below as a matter of convenience.

"Arguments in favor of phases for such distinctions are centered principally on the numbers of series that would have to be established if these criteria were used at the series level. In some States the new series involved would approach or exceed 100 for zonal and intrazonal soils. In some western States, new Alluvial soil series alone would number in the hundreds. For the country as a whole, no accurate estimate can be made at this time, but numbers of series involved would be very large. The problem is greatest in areas of lacustrine sediments, the coastal plain and alluvial soils but it also involves volcanic deposits, loess, glacial outwash, and glacial till to a considerable degree.

"Generally the distinctions are based on differences considered significant to use, management, and productivity of the soils involved. This would commonly involve recognizing series for 3 classes of texture, 2 classes of compaction or permeability, 2 classes of reaction, or presence or absence of carbonates (alone or in combination with 2 or 3 classes of depth to the nonconforming material) for each series based on the solum above the nonconforming material. Thus, for one kind of moderately well drained Podzol solum in sand, there might be 1 series over deep sands, 2 of different thickness over medium-textured material, 2 of different thickness over fine textured material, and additional possibilities for differences of permeability, reaction, or carbonate content of each of the 3 textures.

"It was argued that the sheer numbers of nonconnotative series names would be such a barrier to users of soil surveys that the effectiveness of our work would be seriously impaired. It was pointed out that we are already severely criticized for the numbers of series now used. Although it was not discussed in committee, it is also pertinent that phase distinctions offer a flexibility for adjustment of depths and degree of differences to provide significant distinctions for (1) changing practices in agriculture; (2) different objectives, and (3) increasing knowledge about what constitutes the most critical line to be drawn for a given objective. Recognition of these conditions as series would tend to fix the range included in each unit and the line separating it from other units. Conceivably, phases of these new series, redefinition of the series or additional new series might be needed to provide significant separations in the future.

"The case for recognition of series on the basis of nonconforming substrata is built around four principal considerations:

- (1) A proposal that type and phase distinctions be based on features easily observed at or near the surface and that less easily observed criteria of the subsoil and substratum be used for series distinctions.
- (2) The fact that many long established and well known series are based on nonconforming substrata and would become phases of other series if these were made phase criteria.
- (3) The fact that using phases would be reflected in more heterogeneous low family groups, on which we hope to base management distinctions.
- (4) Long complicated names involving phases of phases for many mapping units.

"Basing type and phase distinctions on characteristics at or near the surface has considerable merit from the standpoint of the layman. They would be things he could easily see and appreciate. It would also make for simplicity of concepts for both laymen and technical people. It would relegate to the nonconnotative series name all properties of the subsoil and substratum, which are most difficult to observe and least well known to the layman. By including all properties of the subsoil and substratum in the abstract series name, one could have more uniform series for agricultural interpretations and simultaneously confine the descriptive type and phase names to things people can see easily, thereby building up the confidence of users.

"There are many long-established and well-known series that might be affected by a decision to use phases for these distinctions. A considerable number, such as Melrose, Rimer, and Allendale, are sandy profiles over clay at given depths and could be considered phases of soils with comparable solums in deep sands. It was mentioned specifically that Fox silt loam, for example, could be considered a gravel substratum phase of Miami. The number of such cases is not known but would undoubtedly be large. If the principal of "phasing" were applied consistently, it would certainly cause considerable disruption of existing concepts and bring criticism of the program from users who are familiar with these soils. This factor is not necessarily involved in the decision, however, for policy could be established to retain those long-established series that would be affected by phasing.

"The committee on low families tentatively has used depth to highly contrasting material as a basis of distinction in that category. This

was done to achieve uniformity of subsoil and substratum for potential agricultural interpretations and limit phases of low families largely to features at or near the surface. It would mean smaller numbers of phases of any one family and simpler interpretive devices from the standpoint of kinds of criteria used as phase distinctions. It would involve about the same absolute number of low family phases. If contrasting substrata were used as phase criteria at the type level, it would, of course, mean inclusion of contrasting substrata both in the series and in the low family. This would require substratum phases of low families to obtain the use and management distinctions wanted for interpretations.

"If contrasting substrata were series criteria, a single word, the series name, would stand for the character of substratum in addition to features of the solum above it. If phases were used, the phase designation would add to an already long and cumbersome name. One would be forced to deal with phases of phases of phases in many instances. One commonly might have names like Ontario gravelly clay loam, moderately deep over shale, severely eroded, 8-15 percent slopes. These names are cumbersome and create a serious barrier to use of survey information. They are troublesome to write and are confusing when used in conversation. If phases were used for contrasting substrata, names like this would be numerous."

The committee recommended last year that the alternatives of using un-conforming substrata as criteria for differentiation of series or for differentiation of phases be referred to the regional work-planning conferences for further consideration. It also recommended that the reactions of farm planners and county agents to the alternatives be obtained in selected states. Criteria for series, types, and phases were considered in each of the four regional work-planning conferences, meeting for the first time this year. Summaries of reactions by regions are as follows:

(a) Northeastern States.

In considering the problem, a committee of the conference obtained reactions from farm planners, county agents, and other agricultural workers to three propositions. These three were:

- (1) Use phases of soil types to differentiate soils having sharply contrasting nonconforming substratum beneath the solum.
- (2) Recognize different soil series in all cases where a highly contrasting nonconforming substratum underlies the solum.
- (3) Retain well known established series for soils having nonconforming substrata but use phases for such conditions in the future.

Reactions were divided on the three propositions, depending upon the soils with which a group of agricultural workers was concerned. Appreciable numbers of such workers were consulted in the course of the inquiry.

The committee recommended that series be differentiated to provide for recognition of unconforming substrata that appeared to have great significance as internal soil characteristics affecting the use, management, and productivity of soils. It also recommended that phases be differentiated for the recognition of unconforming substrata of minor significance, provided any recognition was warranted. These committee recommendations were accepted by the regional conference.

(b) North-Central States.

The problem was illustrated in part in the report of the conference committee by an example showing the gradual thinning of a mantle such as loess over a substratum of sand or till. Thickness of such a mantle might range from many feet down to the vanishing point. Soils might be formed entirely in the mantle, partly in the mantle and partly in the substratum, and where the mantle was completely absent. The range might be continuous from one extreme to the other. Using a mantle of loess overlying till as an example, it might be possible to recognize (1) soils with ABC profiles in loess with no evidence of till in the section, (2) soils with ABCD profiles (D horizon of till), (3) soils with ABD profiles, (4) soils with B horizons partly in loess and partly in till, (5) soils with A horizons in loess and with B and C horizons in till, and (6) soils with ABC profiles in till. There was general agreement that at least three series would be recognized to cover this range of soils, but prevailing practice from that point on was not uniform. Some series have been separated in the past on the following criteria:

- (1) Presence of an unconforming layer at depths of 5 feet or less.
- (2) Difference in depth to an unconforming layer within 5 feet.
- (3) Different kinds of unconforming layers within 5 feet.

The application of these criteria in the differentiation of series has not been uniform within the region.

The committee felt that it would be unwise to devote major effort toward obtaining agreement to use or not to use substrata as criteria for series differentiation. It seemed more important to try for uniformity of approach in the use of substrata as criteria. It was also agreed that series should be distinguished when the substratum had influenced characteristics of the solon, even though the solon differences in such instances were smaller than normally required for series differentiation.

The committee further suggested, and the conference approved, the sending of a questionnaire to each of the twelve states in the region to obtain more information on the scope and size of the problem. Questions to be asked are as follows:

- (1) How have unconforming and highly contrasting substrata below the solum been recognized? As series or phases? Give examples.
- (2) How do you think they should be handled in the future? Why?
- (3) How would you be willing to handle them?

(c) Southern States.

A committee of the regional conference started to prepare an outline of allowable ranges within series in properties such as texture, color, and thickness of horizons. A complete list was not attempted, but an approach was outlined for further trial. The intent was one of trying for more precise statements to define specific ranges in properties allowable within soils series in the Southern States. In its discussions, the committee did not favor the separation of phases exclusively on the basis of properties at or near the soil surface. The committee did favor the use of unlike substrata as phase criteria as a general rule, though some exceptions might be needed. Recommendations of the committee were accepted by the conference.

(d) Western States.

Criteria for differentiating soil series, types, and phases were discussed by the regional conference as a whole rather than in committee. Initial reactions of the conference were to favor the use of unconforming substrata as criteria for the differentiation of phases rather than series. Some participants had reservations, however, because of the importance of profile character to water relations in plant growth. For example, two Desert soils might have essentially identical solums in silty sediments over gravel beds, one with a total depth of 18 inches and the other 50 inches to gravel. Plant growth on the two soils under irrigation would differ appreciably, as would management requirements. Consequently, there might be instances in which unconforming substrata should be considered as criteria for the differentiation of series. The conference did favor the present practice for classification of Alluvial soils into series, types, and phases, as defined in the Soil Survey Manual. It also plans to continue the discussion of unconforming substrata as criteria in the classification of soils.

The reactions of the regional work planning conferences indicate that majority opinion favors general use of unconforming substrata as criteria for distinguishing phases rather than series. A substantial minority prefers the general use of unconforming substrata as criteria for differentiation of series. Exclusive use of unconforming substrata as criteria for differentiation of series or for differentiation of phases has relatively little support. The magnitude of the differences, as well as their existence, seems to come into play in all reactions. At the present stage, the general reaction favors recognition of unconforming substrata by means of phases if the differences are not large while continuing to allow for differentiation of some series if differences are large.

It is expected that further discussions of unconforming substrata as criteria for classification of soils will be held in the regional work-planning conferences. For the most part, these discussions have only started. More definite reactions and additional recommendations may be expected from the regional conferences as the discussions continue.

The problem in dealing with unconforming substrata illustrates a central and continuing one in soil classification, viz. that of selecting and weighting criteria for differentiating classes. Not every property of soils can be used in their classification. Some selection of properties is therefore necessary. Furthermore, several properties must be taken into account in the differentiation of any two classes of equal rank, e.g., soil series or great soil groups. Consequently, the various properties chosen as criteria must be weighed against one another, without benefit of a numerical common denominator. The selection and weighting of properties for differentiating classes at any level are done against the background of understanding of soil genesis and soil behavior held by the soil scientists who are constructing the classification system. Whether it be a comprehensive scheme for the soils of a continent or an interpretive grouping for the soils of a county.

The size and scope of the problem of unconforming substrata can perhaps be outlined more clearly. It is known that problems arise mainly in regions where soils have shallow solums, low degrees of horizonation, or both. It has been estimated that hundreds of new series would have to be recognized if unconforming substrata were always to be criteria for distinguishing soil series. Examination of the current legends in two counties in New York by Dr. Baur indicate that the number of soil series would be increased approximately 15 percent if an unconforming substratum were always a series criterion. The committee proposes to find out what series would be affected and what proportion of the total they are of sample areas, mainly from regions in which the problem exists. Steps are already being taken in this direction by the work-planning conference in the North-Central States.

2. A Proposal to Drop the Phase at and Below the Series Level.

Last year the committee discussed a proposal to drop the present distinction between soil types and phases of soil types, thus giving all classes that would be grouped into one series equal categorical rank. To avoid confusion with present concepts of type and phase, these possible classes will be called subseries in the present committee report. According to the proposal before the committee, the subseries might differ in one or more of texture of surface soil, slope, degree of erosion, stoniness, thickness of solum (minor differences only), and the various other characteristics used in the past to differentiate either soil types or phases of soil types. The present practice of recognizing soil types on the basis of the texture of the surface layer and of subdividing the type into phases would thus be discontinued. Any one or more of a number of criteria might be used to distinguish subseries, which would form the lowest category in the classification system. Furthermore, the subdivision of the soil series into phases would not be permissible though phases, as now defined, might be separated in any class in categories above the series level.

The proposal was discussed at some length by the national committee last year and was also considered briefly by the regional work-planning conferences. A full report of the discussions of last year are embodied in the committee report for 1954. The proposal was reviewed briefly in discussions of the current national committee. Reactions to the proposal are mixed, and further consideration will be required before recommendations can be developed. The probable impact of the change in the classification scheme is closely tied to the nomenclature to be used for mapping units, largely phases as now defined in the Soil Survey Manual. Useful consideration of this proposal will therefore need to be carried on in conjunction with discussions of the possible simplification of the nomenclature for mapping units.

3. Development of a Simplified Phase Nomenclature.

The problem of naming phases was discussed briefly by the national committee a year ago and more recently at some of the regional conferences. Phases of immediate concern are largely the subdivisions of soil types used as mapping units in detailed surveys. The problem of naming these units persists, however, regardless of the level at which they are introduced into the classification system. As a result of its discussions a year ago, the committee made plans to consider the coding of attribute names, either by connotative prefixes or symbols, though no specific scheme was suggested other than the possible use of the slope class letter as a part of the name.

There is general desire for shorter and more convenient names because it is felt that long, cumbersome names are a serious handicap to the full

use of soil survey information. At the same time, there is also a desire to keep the number of independent names in use to the essential minimum. Some degree of conflict between these desires is unavoidable. Whether or not a satisfactory compromise can be developed remains to be seen.

Proposals were laid before two of the regional conferences for using numbers or letters as parts of phase names. It was suggested in the Southern States that Norfolk fine sandy loam, eroded undulating phase might be called Norfolk fine sandy loam (B3). A similar suggestion with three alternatives was developed in the Northeastern States. An example, taking the present name as given in the report for Tioga County, New York, together with three alternatives is as follows:

Mardin channery silt loam, sloping phase

- (1) Mardin channery silt loam 2
- (2) Mardin channery silt loam B
- (3) Mardin channery silt loam 2

Mardin channery silt loam, eroded sloping phase

- (1) Mardin channery silt loam 3
- (2) Mardin channery silt loam CE
- (3) Mardin channery silt loam 2E

Mardin channery silt loam, sloping shallow phase

- (1) Mardin channery silt loam 7
- (2) Mardin channery silt loam CS
- (3) Mardin channery silt loam 2S

The first alternative uses a completely independent, nonconnotative digit as a part of the name. It would simply show that a given phase differed in some respect from all others with different numbers.

The second alternative uses the first letter to identify slope and the second to identify degree of erosion or depth. Under this alternative, three or more letters might be needed to distinguish some phases.

The third alternative uses a number rather than letter for slope, whereas the letter stands for degree of erosion or depth. This is parallel to the second alternative, using one number and a letter instead of several letters.

Further alternatives with this approach would be the use of numbers alone or the use of other arrangements of letters and numbers.

Other possible suggestions for naming of phases were mentioned when the committee report was presented to the national conference. The committee plans to experiment with various approaches in the nomenclature of phases of soil types and of subseries. It is also expected that further efforts in developing simplified nomenclature will be carried on in the regional work-planning conferences.

Committee Members:

Roy W. Simonson, Chairman
A. J. Baur
F. J. Carlisle
T. B. Hutchings
W. M. Johnson
W. S. Ligon
H. H. Morse
O. C. Rogers
Guy D. Smith
E. H. Templin
E. P. Whiteside

St. Louis, Missouri
March 31, 1955

The following notes were recorded during the discussion of the Committee Report on Criteria for Series, Types, and Phases:

Kellogg: What effect does shortening of the solum from underneath have on the problem of choosing a series or a phase name in dealing with unconforming substrata?

Simonson: If the solum is shortened appreciably, a new series is established.

Whiteside: We need to recognize some new series if the highly contrasting substratum below the solum is of such a nature that it markedly affects water relations in the soil. In certain cases we are naming a condition twice; once in the type name and then repeating in the phase name. This can be illustrated in the naming of eroded Miami which originally had a loam surface texture. Removal of surface soil has progressed to the point that a certain amount of the fine-textured B horizon is incorporated in the plow layer making it a clay loam. We now name this soil Miami clay loam, 2 to 7% slope, severely eroded phase. Thus the result of erosion is reflected both in textural type and in the phase name.

Templin: There is need for an additional kind of name for certain subdivisions of series which might be called "variants" or "deviants." These would be subdivisions of a series on some characteristic other than texture of surface soil and named by their deviation from the ortho or normal type. This kind of class seems to correspond with the Belgian "variant." It differs from our present definition of variant in that it is used for named deviations from the normal that lie within the range of the series. An example of use of "variant" in this way is to think of Miami loam as normal and Miami that has become clay loam through erosion as a deviate or variant within the series.

Whiteside: It may be possible to coin names by use of suffixes added to the series to indicate phase characteristics. An example is the addition of "ous" for imperfect drainage; Miami, well drained; Miamious, imperfectly drained.

Johnson: We might study the possibility of adding letters or combinations of letters to the series name to take care of phases. This could be patterned after a system suggested by the Australians. There is a need for a system for symbolizing or giving connotation to part of the soil name.

Kellogg: Dependence on a system of complete symbolization is not good. One could select a few characteristics which could be expressed in symbols, but it would be impossible to symbolize all variations. The system therefore would be incomplete and confusing. Some important things would have to be left out; others of less importance might be overemphasized. Soils have so many characteristics that a coding system would become hopelessly long.

Charter: In the Gold Coast, Africa, series are based on more or less unalterable characteristics. Phases are used for alterable conditions such as certain kinds of vegetation; example: bush phase. Series are named after geographic locations the same as in the U. S. In addition, variations within series may be given geographic phase names using the place name where the variation occurs; example: Marshall silt loam, St. Louis phase.

Orvedal: Retaining textural classes at the type level without confusion with other characteristics is very important to engineering use of soils information. Interpretations made in the development of the world soils map lean heavily on surface texture information.

Carlisle: We need to keep a scientific classification and probably should not depend too much on user reaction when it comes to the choice of criteria for establishing series or phases.

Kellogg: We must keep scientific control in our classification. If necessary a dual soil nomenclature will have to be developed, one for scientific classification and one for popular use.

Arnold J. Baur, Reporter

